

**Attachment 3**  
**PROPOSAL EVALUATION**  
**and**  
**PROPOSAL PREPARATION INSTRUCTIONS**  
**Version 6**

**ADVANCED SIMULATION AND COMPUTING**  
**(ASCI)**

**PURPLE**

**B519700**

**LAWRENCE LIVERMORE NATIONAL LABORATORY**  
**LIVERMORE, CALIFORNIA**

February 15, 2002

# **1 PROPOSAL EVALUATION**

## **1.1 EVALUATION FACTORS**

Evaluation factors are performance features (the combination of mandatory requirements, mandatory option requirements, target requirements and Offeror proposed features), schedule of deliverables, feasibility, supplier attributes and affordability that the University will use to evaluate proposals. The University's assessment of each proposal's evaluation factors will form the basis for selection.

### **1.1.1 DESCRIPTION OF REQUIREMENT CATEGORIES**

The two mandatory requirements (designated MR) in Sections 2.1.1.1 and 3.1.1.1 of the Statement of Work is a performance feature that is essential to the University requirements and an Offeror must satisfactorily propose it in order to have its proposal considered responsive.

Mandatory Option requirements (designated MO) in Sections 2.1.1.10, 2.1.1.11, 2.1.4.9, 3.1.1.3, 3.1.1.4, 4.1.1, 4.1.2, and 5.0 of the Statement of Work deal with features, components, performance characteristics, or upgrades whose availability as options are mandatory. Hence, a proposal that does not include all Mandatory Options will be deemed non-responsive. Because the University may elect to include or exclude such options in a resulting Subcontract, each shall appear as a separately identifiable item in the Price Proposal (Volume IV).

Target Requirements, identified throughout the Statement of Work, are features, components, performance characteristics or other properties that may be considered a part of the systems but will not result in a non-responsive determination if omitted from a proposal. Target requirements are prioritized by dash number. TR-1 is the most important. Target Requirement responses will be considered as part of the evaluation of Technical Proposal Excellence.

Taken together, the aggregate of the MR, MO and TR-1 requirements form a baseline system. TR-1 targets are as important to the program as mandatory requirements, but not meeting any particular TR-1 target requirement is insufficient to render a proposal non-responsive. TR-2 targets are second priority after TR-1 requirements. TR-2 requirements are considered goals that boost a baseline system, taken together as an aggregate of MR, MO, TR-1 and TR-2 requirements, into the moderately useful category. TR-3 targets are third priority after TR-2 requirements. TR-3 requirements are considered stretch goals that boost a moderately useful system, taken together as an aggregate of MR, MO, TR-1, TR-2 and TR-3 requirements, into the highly useful category. Thus, the ideal ASCI Early Deployment of Technology Vehicle (EDTV) and Purple systems will meet or exceed all MR, MO, TR-1, TR-2 and TR-3 requirements.

### **1.1.2 PERFORMANCE FEATURES**

#### **Technical Proposal Excellence**

The University will assess how well an Offeror's technical proposal addresses and exceeds the Statement of Work (SOW) target requirements. An Offeror is not solely limited to discussion of these features. An Offeror may propose other features or attributes if the Offeror believes they may

be of value to the University. If the University agrees, consideration may be given to them in the evaluation process. In all cases, the University will assess the value of each proposal as submitted.

As an example, although proprietary UNIX solutions may initially have greater congruence with Purple technical requirements, the University realizes that well conceived Open Source based proposals that cogently address gaps between existing Linux clustering solutions and Purple requirements could be of great benefit to the entire HPTC community. Therefore, the University places sufficient strategic value on Open Source Linux development efforts pertinently addressing these key missing technologies, that these offerings are equally valuable when compared to existing proprietary UNIX solutions.

The University will evaluate the following performance features.

- The University will assess the performance of the benchmarks on the proposed systems.
- The University will determine the degree to which the technical proposal meets or exceeds the target requirements.
- The University will evaluate how well the proposed solution meets the overall programmatic objectives expressed in the SOW.
- The University will evaluate proposed hardware and software support model and determine how this model will provide at least five years of practical system maintenance. Specifically, the University will assess how well the maintenance model should work in practice.
- The University will evaluate the proposed Open Source software development projects which address key technological areas for HPTC clustering that directly address Purple requirements with a Linux/Open Source solution.

#### **Additional Performance Features**

Additional performance features are also qualitative criteria, over and above the target requirements, the University will use for the subjective evaluation of proposals. Offeror should address the additional performance features identified here in its RFP response and are encouraged to propose other characteristics that Offeror considers value-related. The University has identified the following additional performance features for this RFP. They are not listed in any order of importance.

- The University will assess overall system **sustained performance** characteristics, such as CPU performance; cache, memory bandwidth; and cluster interconnect latency and bandwidth, both component and aggregate.
- **The University will evaluate delivered message-passing performance and scalability**, including the delivered bandwidth and latency to MPI only and mixed MPI/OpenMP applications, both component and aggregate.
- The University will evaluate functionality, performance, and scalability of proposed systems.
- The University will assess quality and quantity of the Benchmark results, as described below and in the SOW Section 9. Of particular interest are the results for Tier one applications and the ESP rating.
- The University will assess completeness of Storage Area Networking (SAN) offering and vision including extending the SAN and Cluster Wide File System (CWFS) beyond the proposed systems to the heterogeneous environment of the LLNL Secure Computing Facility (SCF).
- The University will assess creative visualization offering for augmenting the proposed systems with substantial visualization capability.

- The University will assess functionality, performance and scalability in areas such as programming environment, tools, and interfaces as described in the SOW Sections 2.2.5, 2.2.6, 2.2.7 and 2.2.8.
- The University will evaluate functionality, performance and scalability in providing a single system image and system administration areas such as operating system and associated system components (including partitioning, dual boot and local file system), resource and accounting management, and related software.
- The University will evaluate minimization of physical plant requirements, such as footprint, power, and cooling.
- The University will assess credible roadmaps for hardware and software.
- The University will assess realism and completeness of work breakdown structure.
- The University will evaluate support of official and de facto standards for hardware and software and open source development of software.
- The University will assess reliability, availability, and serviceability of the system, such as MTBF, MTTR, hardware and software failsafe features, and data protection mechanisms.
- The University will evaluate level and quality of proposed hardware, software and applications maintenance and support. If Linux and/or open source components are proposed, then the **quality and feasibility of the support model for open source components** must be realistically and persuasively addressed.
- The University will assess overall system design and configuration balance to reduce performance bottlenecks.

### **1.1.3 FEASIBILITY OF THE SCHEDULE OF DELIVERABLES**

Schedule is of critical importance to the ASCI program. The University will assess the deliverable schedule. The University will consider the realism of the proposed delivery schedule given the Offeror's development, manufacturing, testing facilities, support offering and the quality and roll out of technology proposed in the project and management plans. The University will evaluate the realism and completeness of the project Gantt chart.

### **1.1.4 FEASIBILITY OF SUCCESSFUL PERFORMANCE**

The University will assess the likelihood that the Offeror's systems will work as proposed. The University will assess the likelihood that the schedule of deliverables leads from the EDTV to Purple with an achievable development and deployment of technology. The University will also assess the risks, to both the Offeror and the University, associated with the proposed solution. The University will evaluate how well the proposed technical approach and solutions align with the Offeror's corporate product roadmap and the level of corporate commitment to the project.

### **1.1.5 SUPPLIER ATTRIBUTES**

#### **Capability**

The University will review the Offeror's experience and past performance in providing high-end computing systems and assess its demonstrated commitment to high-end computing customers. See Part 4.1 for further information.

- The University will consider the quality and scope of the Offeror's performance record.
- The University will review the Offeror's demonstrated ability to meet schedule and delivery promises.
- The University will determine the credibility of the Offeror's cluster strategy.

- The University will assess the alignment of this proposal with the Offeror's product strategy.
- The University will evaluate the Offeror's demonstrated ability to meet schedule for new product releases and delivery of large, state-of-the-art systems.
- The University will evaluate the Offeror's demonstrated ability to successfully work as a member of a large-system integration project.
- The University will assess the Offeror's history of working with third parties to ensure third-party software or other components operate correctly on the system.
- The University will assess expertise and skill level of key personnel.
- The University will evaluate the contribution of the management plan and key personnel to successful and timely completion of the work.
- The University will assess the Offeror's financial condition. See Part 6.6 for further information.
- The University is particularly concerned that the Offeror has adequate financial resources to perform the Subcontract.

If a proposal is submitted by a consortium led by an integrating subcontractor (as opposed to the primary original equipment manufacturer), the University will assess the likelihood that the integrating subcontractor can ensure the responsiveness of its partners in the consortium to the performance requirements for the duration of the Subcontract. This assessment will be based on the proposed detailed consortium management plan that explains the corporate relationships and responsibilities between or among the parties to the consortium and any other information provided by the Offeror or available to the University. The University believes that only aggressive, top-level management relationships that clearly identify who is responsible for what among the members of the consortium can reduce the performance risk posed by the integrating subcontractor-led consortium approach. In particular, the University will assess how component hardware and software development, hardware and software bug fix, system testing and problem root cause identification and resolution (*FOR ALL PROPOSED HARDWARE AND SOFTWARE*, not only those developed directly by the consortium) responsibility is assigned and committed to in the proposed management plan.

If the Offeror proposes a Linux solution with some or all Open Source development model, then the University will determine the applicability to meeting Purple requirements and credibility of the Offeror's proposal based on the proposed Open Source development and support.

- The University will assess the Offeror's experience and past performance in providing Open Source solutions.
- The University will determine the credibility of the Offeror's Linux cluster strategy.
- The University will assess the alignment of this proposal with the Offeror's Linux strategy.
- The University will highly value Open Source technology offered as part of the alliance that addresses key Purple requirements.
- The University will assess the proposed in-house and consortium development and support resources for these efforts. If an Open Source consortium model is proposed for development efforts, then the past performance of this consortium, consortium membership and the willingness and commitment of the consortium to work on the proposed development effort will be assessed.

### **1.1.6 AFFORDABILITY**

The proposal shall include a total firm fixed price for the work and a delivery schedule. The University requires delivery of technology consistent with the SOW as listed in the System Requirements Summary Matrix in Section 3.1.1, Table 2. Early delivery of technology is encouraged.

- The University will evaluate reasonableness of the total proposed price and the prices of proposed components and options in a competitive environment.
- The University will evaluate the proposed price compared to the perceived value.
- The University will assess the life cycle costs compared to those of the competition.
- The University will evaluate price trade offs and options embodied in the Offeror's proposal.
- The University will evaluate financial considerations, such as price versus value and financial incentives.

## **1.2 BASIS FOR SELECTION**

The University intends to select the Offeror whose proposal satisfies the mandatory requirements and mandatory option requirements, and offers target requirements whose performance features, schedule of deliverables, feasibility, supplier attributes and affordability offer the best overall value to the University. The University will determine the best overall value by comparing differences in technical excellence, schedule and supplier attributes offered with differences in affordability, striking the most advantageous balance between expected performance and the overall affordability to the University. Offerors must, therefore, be persuasive in describing the value of their proposed solutions, schedules and supplier attributes in enhancing the likelihood of successful performance or otherwise best achieving the University's programmatic objectives. The University may select the Offeror whose proposal is considered to offer the best overall value compared to proposals with either higher or lower prices. The University's selection may be made on the basis of the initial proposals or the University may elect to negotiate with any or all Offerors. **The University reserves the right to award subcontracts to one or more Offerors and to award a Subcontract based on all or part of an Offeror's proposal.**

## **1.3 OPTIONS**

The University may, at its sole discretion, award any proposed Mandatory Option at time of subcontract award. The University and the Offeror may also elect to include any proposed Mandatory Option in the subcontract with an option exercise date agreeable to the parties for each option.

The University intends to award the Purple System at either the 60 teraFLOP/s or the 100 teraFLOP/s peak performance level, but not both. That is, the University will not award two Purple systems. The University's possible EDTV award scenarios are as follows.

No EDTV at all

One each EDTV of 5 teraFLOP/s performance level

One each EDTV of 20 teraFLOP/s performance level

Two each EDTV of 5 teraFLOP/s performance level

Two each EDTV of 20 teraFLOP/S performance level

One each EDTV of 5 teraFLOP/s performance level and one each EDTV of 20 teraFLOP/s performance level

The first EDTV, if awarded by the University, will be delivered to LLNL. The second EDTV, if awarded by the University, will be delivered to another site as directed by the University. Any

technology refresh options or alternate configurations proposed by the Offeror may, at its sole discretion, be awarded by the University. In addition, the Visualization Mandatory Option and other memory or I/O options, may awarded by the University at its sole discretion.

## **2 GENERAL PROPOSAL INFORMATION**

### **2.1 PROPOSAL FORMAT**

Please submit TEN paper copies and TWO electronic copies of your proposal as indicated. All proposal paper copies should be presented using 8 1/2 by 11-inch paper in loose-leaf binders. The page limit for the Technical Proposal (Volume I) is 250 pages and for the Business Proposal (Volume II) is 40 pages, and is defined as consecutively numbered pages. The page limit for the Alternate Proposals and Options (Volume III) is 250 pages. There is no page limit for the Price Proposal (Volume IV) and Other Documents (Volume V) portions of the proposals. At least 12-point font shall be used and the paper copies must be printed on one side only. The electronic copies of the entire proposal shall be in Microsoft Office 2000 or XP (Word, Excel, PowerPoint, Project and Visio), PDF format, or Rich Text Format. Electronic media shall be virus free. Should any inconsistencies exist between the Offeror's paper copy proposal and the documents submitted on electronic media, the paper copy form of the Offeror's proposal shall take precedence. An Offeror's proposal submission will be structured in accordance with the following Table 1.

**Table 1**  
**Proposal Format**

<b>VOLUME—SECTION NUMBER</b>
<b>Volume I Technical Proposal (250 page limit total)</b> Section 1. System(s) Overview Section 2. Purple High-Level Requirements Section 3. EDTV High-Level Requirements Section 4. Visualization Requirements Section 5. Integrated System Requirements Section 6. Facilities Requirements Section 7. Project Management Section 8. Performance of the System Section 9. Subcontracting
<b>Volume II Business Proposal (40 page limit total)</b> Section 1. Supplier Attributes Section 2. Unix/Linux Product Roadmap Section 3. Proposed Open Source Development Partnerships
<b>Volume III Alternate Proposals and Options (250 page limit total)</b> Section 1. Overview Section 2. System Description Section 3. Visualization Requirements Section 4. Integrated System Requirements Section 5. Facilities Requirements Section 6. Subcontracting

<b>VOLUME—SECTION NUMBER</b>
<b>Volume IV Price Proposal</b> ( <i>no page limit</i> )
Section 1. System Prices
Section 2. University and Offeror Defined Options Prices
Section 3. Lower-Tier Subcontractor Prices
Section 4. Milestone Payment Schedule
Section 5. Financial Incentives
Section 6. Financial Condition and Capability
<b>Volume V Other Documents</b> ( <i>no page limit</i> )
Section 1. Royalty Information
Section 2. Integrated Safety Management (ISM) Requirement
Section 3. Software Branding and Licenses, if applicable
Section 4. System Warranty Information
Section 5. Representations and Certifications
Section 6. EEO Pre-Award Compliance Certification Form
Section 7. Supplier's Industrial Safety Record

### **3 TECHNICAL PROPOSAL (VOLUME I)**

In the Technical Proposal, the Offeror shall describe the systems proposed. This shall be written in the form of an integrated narrative **and shall include a point-by-point response to the technical requirements contained in the Statement of Work with the same numbering scheme as the Statement of Work.** This narrative shall include a description of each of the proposed systems and technology refresh steps. The Technical Proposal shall be divided into the following tabbed sections.

#### **3.1 Section 1: System(s) Overview**

Offeror's technical proposal response (Volume 1, Section 1) shall contain an executive summary of the proposed systems hardware and software system(s) that provides a brief overview of what will be delivered, major functional and performance capabilities, a list definitions and acronyms, a fully completed system architecture summary matrix, a systems software overview, a fully completed systems requirements summary matrix, a systems detailed hardware overview, a systems detailed software overview, and a timeline of deliverables. Details on what information should be included for each of these items are listed in the following subsections.

##### **3.1.1 System Architecture Summary Matrix**

The following matrix shall be completed in its entirety. All entries shall be cross-referenced to the section and/or page number in the proposal that contains this information. The system architecture summary matrix will be completed for the proposed EDTV, any proposed technology refresh steps and the final Purple system.

**Table 2**  
**System Architecture Summary Matrix**

<b>Attribute</b>	<b>EDTV System</b>	<b>Technology Refreshes (if applicable)</b>	<b>Purple System</b>
------------------	--------------------	---	----------------------



	<i>Description</i>	<i>Proposal Cross- Reference</i>	<i>Description</i>	<i>Proposal Cross- Reference</i>	<i>Description</i>	<i>Proposal Cross- Reference</i>
<b>Number of SMPs</b>						
<b>Processor Type</b>						
<b>Frequency</b>						
<b>Number of Processors/SMP</b>						
<b>Total Number of Processors</b>						
<b>Required SMP Partitioning</b>						
<b>Total Memory Size</b>						
<b>Memory Size B:F</b>						
<b>Memory Type</b> (size and bandwidth)						
<b>Memory Size</b> (proposed memory capacity per board and total capacity per board)						
<b>Latencies</b> L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
<b>Bandwidths</b> L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
<b>Sizes</b> L1 Cache L2 Cache L3 Cache L4 Cache Memory Remote memory Off-box Off-box MPI						
<b>Aggregate Local Disk Size</b>						
<b>Global Disk Size</b>						
<b>Delivered Global I/O Rate</b>						
<b>Cluster Interconnect</b>						
<b>Interconnect Node B:F</b>						
<b>Interconnect Bisection B:F</b>						
<b>External Network Connection</b> (Type and Number)						
<b>System Hardware MTBF</b>						
<b>System Software MTBF</b>						
<b>Total System Power (MVA)</b>						

Attribute	EDTV System		Technology Refreshes (if applicable)		Purple System	
	<i>Description</i>	<i>Proposal Cross- Reference</i>	<i>Description</i>	<i>Proposal Cross- Reference</i>	<i>Description</i>	<i>Proposal Cross- Reference</i>
<b>Total System Footprint</b> (sq. ft.) (including peripherals and clearances)						
<b>Demonstration Date</b>						
<b>Delivery Date</b>						
<b>System Availability Date</b>						

### 3.1.2 Systems Software Overview

Provide an overview of the software to be delivered with the EDTV, Purple system and Technology Refreshes, as appropriate. This description should be high level and include every major component of software. Provide the following information for each software product proposed.

- Product Source. Is the software proprietary, third party, or open source?
- The degree to which the software conforms to standards, if applicable
- Whether it is an evolution of an existing product or a new product
- Availability schedule, including the availability of Beta or early-access versions
- Salient features and functions to be included in each version
- Relationship between the availability of this product and that of the other proposed software products. Does the availability of this product depend upon the availability of features and functions in other software to be delivered?
- Product features that you believe are particularly noteworthy and distinguish your product from others
- Describe whether the product operates between SMPs as well as within SMPs

### 3.1.3 System Requirements Summary Matrix

The following matrix identifies the mandatory requirements (MR), mandatory option requirements (MO), and highest priority target requirements (TR-1). The matrix shall be completed in its entirety. All entries shall be cross-referenced to the section in the proposal that contains this information or labeled N/A if the requirement is not offered. The system requirements summary matrix will be completed for the proposed EDTV, any proposed technology refresh steps and the final Purple system. In addition, the system requirements summary matrix will be completed for any alternate proposed systems submitted.

**Table 3**  
**System Requirements Summary Matrix**

Index	Requirement Description	EDTV System	Purple System
		<i>Proposal Cross- Reference</i>	<i>Proposal Cross- Reference</i>
2.1.1.1	Purple Scalable SMP Cluster (MR)		
2.1.1.2	Purple Component Scaling (TR-1)		
2.1.1.3	Additional Applications Memory (TR-1)		
2.1.1.6	Cluster Interconnect Link Delivered Bandwidth (TR-1)		
2.1.1.7	Cluster Interconnect Latency (TR-1)		
2.1.1.8	Scalable Cluster Global Operations (TR-1)		

Index	Requirement Description	EDTV System	Purple System
		<i>Proposal Cross-Reference</i>	<i>Proposal Cross-Reference</i>
2.1.1.10	Additional Applications Memory for Cluster (MO)		
2.1.1.11	Additional Applications Memory for Compute SMP (MO)		
2.1.2.1	SMP Platform (TR-1)		
2.1.2.2	CPU Characteristics (TR-1)		
2.1.2.5	Test-And-Set Instruction (TR-1)		
2.1.2.9	Hardware Performance Monitors (TR-1)		
2.1.2.10	Hardware Debugging Support (TR-1)		
2.1.3.1	Shared Main Memory (TR-1)		
2.1.3.1	Purple System Architecture (TR-1)		
2.1.3.2	Purple Clustered Wide File System and System Node Model (TR-1)		
2.1.3.3	Purple High-Availability RAID Arrays (TR-1)		
2.1.3.4	Purple Dual Boot Capability and Local Disk Space (TR-1)		
2.1.3.5	Single Process Sustained Serial I/O Bandwidth (TR-1)		
2.1.3.6	Multiple Sustained Serial I/O Bandwidth to Local Disk (TR-1)		
2.1.3.7	Parallel Sustained I/O Bandwidth (TR-1)		
2.1.3.7.1	Parallel CFWF Defensive I/O Bandwidth (TR-1)		
2.1.3.7.2	CWFS Productive I/O Bandwidth (TR-1)		
2.1.3.7.3	Measuring CWFS Total I/O Bandwidth (TR-1)		
2.1.3.8	Cluster High Speed External Network Interfaces (TR-1)		
2.1.3.9	Additional Global Disk (MO)		
2.1.5	Early Access to Purple Hardware Technology (TR-1)		
2.2.1.1	SMP Base Operating System and License (TR-1)		
2.2.1.5	Dual Boot Capability (TR-1)		
2.2.1.6	Pluggable Authentication Mechanism (TR-1)		
2.2.1.10	Networking Protocols (TR-1)		
2.2.1.13	Cluster Wide File System (TR-1)		
2.2.2.1	OSF DCE (TR-1)		
2.2.2.2	Distributed File System Server (TR-1)		
2.2.2.3	Cluster Wide Service Security (TR-1)		
2.2.3.1	Job definition (TR-1)		
2.2.3.2	Minimal Resource Set (TR-1)		
2.2.3.3	Cluster Wide Job Management (TR-1)		
2.2.3.6.1	Fast, Scalable and Reliable Job Launch (TR-1)		
2.2.4.1	Single Point for Cluster System Administration (TR-1)		
2.2.4.1.1	Fast, Reliable System Reboot (TR-1)		
2.2.4.1.2	Fast Software Installation and Reversion (TR-1)		
2.2.4.1.3	Fast Software Patch Installation (TR-1)		
2.2.4.1.4	Alternate Configuration Boot, Install and Patch (TR-1)		
2.2.5.1	Baseline Languages (TR-1)		
2.2.5.2	Baseline Language 64b Pointer Default (TR-1)		
2.2.5.3	Baseline Language Standardization Tracking (TR-1)		
2.2.5.9	Baseline Language Support for OpenMP Parallelism (TR-1)		
2.2.6.1	Debugger for Cluster Wide Applications (TR-1)		
2.2.6.4	Profiling Tools for Cluster Applications (TR-1)		
2.2.6.5	Event Tracing Tools for Cluster Applications (TR-1)		
2.2.6.5.1	Binary Event Trace Output Translation (TR-1)		
2.2.6.6	Performance Statistics Tools for Cluster Applications (TR-1)		
2.2.6.8	Cluster Wide Application Development Tool GUI (TR-1)		
2.2.7.1	Linker and Library Building Utility (TR-1)		
2.2.7.2	Make Utility (TR-1)		
2.2.8.1	Optimized Message-Passing Interface (MPI) Library (TR-1)		
2.2.8.4	Graphical User Interface API (TR-1)		

Index	Requirement Description	EDTV System	Purple System
		<i>Proposal Cross-Reference</i>	<i>Proposal Cross-Reference</i>
2.2.9.2	Audit Capability (TR-1)		
2.2.10	Compliance with DOE Security Mandates (TR-1)		
2.2.12	Early Access to Purple Software Technology (TR-1)		
3.0	Purple C Option (MO)		
3.1.1.1	Purple Scalable SMP Cluster (MR)		
3.1.1.2	Purple Component Scaling (TR-1)		
3.1.1.3	Additional Applications Memory for Cluster (MO)		
3.1.1.4	Additional Applications Memory for Compute SMP (MO)		
4.1.1	EDTV-5 SMP Cluster (MO)		
4.1.2	EDTV-20 SMP Cluster (MO)		
4.1.3	EDTV RED/BLACK Static Split (TR-1)		
5.0	Visualization Requirements (MO)		
5.1	Visualization Hardware Requirements (TR-1)		
5.1.1	Visualization Hardware Cluster Interconnect (TR-1)		
5.1.2	Direct Access to CWFS (TR-1)		
5.1.4	Hardware Rendering SMP Memory Size (TR-1)		
5.1.5	SMPs Augmented with Hardware Graphics Accelerators (TR-1)		
5.1.6.1	Bandwidth Requirements (TR-1)		
5.2.3	Graphics API Support (TR-1)		
6.1.1	Capability Application Reliability (TR-1)		
6.1.6	Scalable RAS Infrastructure (TR-1)		
6.1.6.1	Scalable System Monitoring (TR-1)		
6.1.6.2	Highly Reliable RAS Infrastructure (TR-1)		
6.1.10	Replacement Parts and Maintenance (TR-1)		
6.1.10.1	On-Site Parts Cache (TR-1)		
6.1.10.2	Response Time and Node Replacement (TR-1)		
6.1.11	On-Site Analyst Support (TR-1)		
6.2.1	Minimum ESP rating (TR-1)		
6.2.2	Improving ESP rating (TR-1)		
7.1	Power & Cooling Requirements (TR-1)		
7.2	Floor Space Requirements (TR-1)		
7.2.1	EDTV Floor Space Requirement (TR-1)		
7.2.2	Purple Floor Space Requirement (TR-1)		
8.1	Performance Reviews (TR-1)		
8.2.1	Full-Term Project Management Plan (TR-1)		
8.2.2	Full-Term Hardware Development Plan (TR-1)		
8.2.3	Full-Term Software Development Plan (TR-1)		
8.2.4	Detailed Year Plan (TR-1)		
8.3	Project Milestones (TR-1)		
8.3.1	Full-Term Purple Plan of Record (TR-1)		
8.3.2	EDTV On-Site Support Personnel (TR-1)		
8.3.3	Early Deployment of Technology Vehicle Demonstration (TR-1)		
8.3.4	Early Deployment of Technology Vehicle Acceptance (TR-1)		
8.3.5	CY03 Plan and Review (TR-1)		
8.3.7	CY04 Plan and Review (TR-1)		
8.3.8	Purple Build (TR-1)		
8.3.9	Purple Demonstration (TR-1)		
8.3.10	CY05 Plan and Review (TR-1)		
8.3.11	Purple Acceptance and Limited Availability (TR-1)		
8.3.12	Purple General Availability Status (TR-1)		
8.3.13	Combined Open EDTV System (TR-1)		
8.3.14	CY06 Plan and Review (TR-1)		

Index	Requirement Description	EDTV System	Purple System
		<i>Proposal Cross-Reference</i>	<i>Proposal Cross-Reference</i>
9.1.1	sPPM Marquee Demonstration Code (TR-1)		
9.1.2	UMT2000 Marquee Demonstration Code (TR-1)		
9.3	System Configuration (TR-1)		
9.4	Test Procedures (TR-1)		
9.5	Measured ESP (TR-1)		

### 3.1.4 Systems Detailed Hardware Overview

This section shall present a detailed hardware technical description of the components of the proposed EDTV, Purple systems and Technology Refreshes, as appropriate, described above in the Overview. The features and functionality of all major components of the system shall be discussed in detail as well as the areas of risk and risk mitigation. These technical descriptions should be targeted to the specific proposed configurations, not general product roadmap marketing hype. The discussion shall include, in the order stated, but not be limited to, the following.

- Processor.** Two distinct descriptions should be provided. First, the Instruction Set Architecture or ISA should be described. Second, the microarchitecture of the processor should be described in detail. This description should include all of the processor components, instruction size in bytes, numbers and types of registers, and superscalar instruction dispatch characteristics as well as other processor features such as branch prediction, pipelining characteristics. The stall characteristics and how many outstanding loads and stores are tolerated before the onset of stall should be discussed. A block diagram of the processor should also be included.
- Memory Hierarchy.** This description should be an “inside out” description, beginning with a description of the innermost level of cache, to the next cache level out, to main memory. For each level of the hierarchy, the cache line or word size should be noted, along with bandwidths and latencies in paths to and from the levels above and below. The associativity of the cache levels as well as the method of cache coherency should be described. The characteristics of both instruction and data caches should be described if the caches are not shared. Describe the shared memory access patterns for the SMP (i.e., whether the memory is Uniform Access, Non-Uniform Access, Cache Only Access, etc.).
- SMP.** Describe the number of processors, amount of physical memory, and the internal SMP interconnect, including bandwidths and latencies. Describe the external I/O interconnects including those for disk and external network connections, as well as system interconnects to other SMPs or to the switching fabric, including bandwidths and latencies. A block diagram of the SMP should be provided. Describe the topological aspects of the communication between the processors and associated memory. Describe any partitioning mechanisms and how that affects the configuration and I/O subsystem for OS booting. Explain how the OS dual boot capability is accomplished for each partition from a hardware point of view. Explain how partitioning affects the memory hierarchy, the cluster interconnect connections and any other SMP hardware impacts.
- Compute SMP Homogeneity.** Confirm whether or not the compute nodes for the proposed systems are homogeneous in terms of processors and architecture. If they are not homogeneous, describe in what way they are not and the rationale for the decision.
- Cluster Interconnect.** Describe all cluster interconnect components, including switches and switch hierarchies, if present, as well as bandwidths and latencies, both per link and bi-section or aggregate. The number of interconnect links per SMP should be described as well as the number of hops a message must take to reach its destination. Describe the topology of the SMP interconnection when viewed as a whole, as well as the protocol used at the link and network

layers. Estimate hardware transmission error rates and describe how errors are detected and repaired automatically by the hardware, if available. Include any viewing aids, such as block diagrams, etc., you believe would be helpful.

- Global I/O Subsystem.** Provide a block diagram for the proposed I/O subsystem especially the SAN interconnect. Label this diagram with the bandwidths and latencies of each component. Describe the number and types of connections from the SMPs to the SAN interconnect. Describe the network in all of its detail, including number and type of switches as well as the topology of the network. Provide the bisection bandwidth for the SAN network and describe how it was calculated. Describe how this SAN network can be extended to add additional global disk capacity and bandwidth and additional ports for heterogeneous devices (e.g., SMPs from other vendors, RAID devices from other vendors, etc.). In addition, provide data regarding the capacities, revolutions per minute, bandwidths, latencies of the disks themselves, and what level of RAID may be used to access the disk. Describe hardware features that enhance parallel, global access. Estimate the overall delivered bandwidth for each component from the disks to RAID devices through the I/O subsystem. Specifically delineate the bottlenecks (performance limiters) in the I/O subsystem.
- External Networking Subsystem.** Provide a block diagram for the proposed external networking subsystem. If the proposed solution is based TCP/IP off-load engines (TOEs) attached to the SAN network, describe how these devices are accessed from the login SMPs. If the proposed solution is based on network adapters directly attached to the login nodes, describe this attachment and limitations on performance. Describe the number and type of external networking ports.
- Reliability, Availability, and Serviceability Subsystem (RAS).** Provide a description of the Offeror's hardware RAS strategy for single SMPs and the entire cluster for each EDTV, Tech Refresh (if proposed), and Purple and explain how this is implemented in the proposed hardware. The maintenance console, if separate, should be described, as should any hardware enhancements such as redundancy, disk mirroring, or separate hardware diagnostic networks. Provide the Mean Time Between Application Failures (MTBAF) calculation for the entire Final System. The predicted MTBAF is the mean time between application termination due to hardware failure. Any hardware failures that do not cause an application to terminate (e.g., single disk failure in a RAID group, single power supply in an N+1 power supply configuration), but may require the application to run at a reduced performance level or degraded mode do not count as an application termination due to hardware failure event. Like all scientific simulations, ASCI applications are not written to be hardware fault tolerant and will terminate on a CPU, node, SMP, interconnect or CWFS failure. This calculation shall be performed using a recognized standard. Examples of such standards are Military Standard (Mil Std) 756, Reliability Modeling and Prediction, which can be found in Military Handbook 217F, and the Sum of Parts Method outlined in Bellcore Technical Reference manual 332. Include the actual calculations performed to derive the system MTBAF number. Describe hardware failure modes that do not cause applications to terminate. Describe the hardware preventative maintenance approach. Describe system level diagnostics.

### **3.1.5 Systems Detailed Software Overview**

This section should present a detailed software technical description of the components of the proposed EDTV, Purple systems and Technology Refreshes, as appropriate, described above in the Overview. For each software component provided, the discussion shall include how the software will scale across the entire system and the anticipated start-up time. The features and functionality of all major components of the system shall be discussed in detail as well as the areas of risk and risk

mitigation. Discuss the intellectual property status of the software components: vendor proprietary, third party, Open Source. These technical descriptions should be targeted to the specific proposed configurations, not general product roadmap marketing hype. It shall also include, in the order stated, but not be limited to, the following.

- **Operating System.** Describe features such as threads packages provided; scheduling features such as gang, real time, or fair share; hardware counters available through the OS; interprocess communication features provided; and, checkpoint/restart features if available. Describe OS RAS features. Describe the local file system and features such as journaling, volume management and RAS. Describe the node and SMP booting sequence and estimate the reboot time. Describe how the dual boot environment must be configured and utilized to maintain two different software releases simultaneously. Describe core services (daemons) that are required to run on the cluster nodes in order to provide core cluster services. Provide MTBF statistics for the OS and core services.
- **System Administration.** Describe key system administration features that allow the systems to be managed productively by a limited system administration staff. Describe such features as configuration management, change notification, and a description of the GUI for administering the entire system. Identify the amount of time required for shutting down and rebooting a node or SMP as well as the entire cluster. Describe the effect of rebooting a single SMP on the rest of the cluster. Describe any parallel administration capability. In particular, indicate any system status database functionality and how it performs under load (e.g., system shutdown/reboot and network storm events).
- **Global File System.** Provide an architectural diagram of the global file system including all key components and communication mechanisms and protocols. Describe the global lock manager and its granularity. Describe the system resources required by the global file system (e.g., file server nodes, strip group managers and back-ups, lock managers and back-ups, etc.). Estimate the number of I/O and service nodes required to support the proposed parallel I/O rates and services. Provide background data, actual measurements, and estimates supporting Offeror assertion that this configuration achieves the proposed global I/O rates. Describe how the global file system utilizes and manages the SAN infrastructure. Describe mechanisms for providing global file system services to the compute nodes and what impact on compute node system resources this service requires. Describe the mechanisms for providing global file system services to other heterogeneous resources (e.g., Linux capacity clusters, legacy visualization resources running Irix™ and the High Performance Storage System archive running on AIX™) that may be attached to the SAN network in the future. Describe features such as maximum global file size, global access capability, and parallel I/O capability.
- **Application Development Environment.** Describe the features and functionality of compilers, debuggers, linking features such as dynamic shared libraries, performance analysis and tuning tools. Indicate how well the compiler can optimize and parallelize code both with and without debugging support. Describe any compiler optimizations or directives for NUMA memory layout. Give a full list of all known compiler features and limitations (not bugs) such as support for C++ standard extensions. Describe how the hardware performance monitors are available to users via an API and what provided code development tools utilize these features. Discuss the MPI performance analysis tools features and limitations (not bugs) and how they will scale to the proposed system.
- **Message Passing System.** Include a description of OS bypass capability, if applicable, and message striping, if available. Describe the capability to select or reject a particular cluster interconnect interface card. Explain how the MPI library handles multiple network planes per node or SMP, if proposed. Explain how the MPI library will scale to the size of the system

including pinned and non-pinned buffer allocations required and time estimates for MPI global operations (e.g., MPI\_Allreduce, MPI\_Barrier). Explain how the MPI library takes advantage of the node or SMP shared memory and how this actually improves performance. Give a full list of all known MPI limitations (not bugs) such as task limits, number of tasks per node or SMP.

- **System Security Features.** Describe discretionary access controls and mandatory access controls, if available.
- **Accounting System.** Describe process, job, and/or project accounting and if the sampling rate is more frequent than end of process accounting, if available. Indicate if there are any provided mechanisms for aggregating the node accounting data.
- **Resource Management.** Provide an architectural diagram of the resource management system including all key components and communication mechanisms and protocols. Include descriptions of mechanisms for process and job discovery and control. Describe mechanisms that control interactive usage. Provide a systems administrators and users guide to the resource management system. Any enhancements to scheduling, such as fair-share, should be described, as well as standard queue mechanisms. Describe Offeror's strategy for achieving required ESP ratings. Describe Offeror's strategy for achieving the required capability application reliability.
- **Reliability, Availability, and Serviceability Software.** Provide a description of the Offeror's software RAS strategy for single SMPs and the entire cluster for each system and how this is implemented in the proposed software. Describe features such as system-wide checkpoint/restart, ability to Up and Down hardware through software, and online diagnostic capability.

### **3.1.6 Timeline of Deliverables**

Provide a single timeline that includes all the hardware and software being delivered. The timeline shall identify the functions and features anticipated to be included in each delivery. Early access hardware and software, such as Alpha and Beta releases, are also of interest and, if offered, shall be included in the timeline as well.

Due to the size of the Purple system, Offeror may propose the delivery and installation in stages. This is the build-deliver-demo scenario. However, if the Offeror can first stage the system at the Offeror's facilities for debugging and stabilization and demonstration before delivery, that is preferred. This scenario is the build-demo-deliver scenario. If a build-deliver-demo scenario is proposed, please provide a description of the items to be delivered at each stage and the beginning and end dates for each delivery. Include the same information contained in Matrix 1 for each staged delivery. The SMPs delivered in each of the stages should contain a proportionate amount of memory, interconnect, and disk so that the SMPs are usable and can be handed over to the ASCI code developers as soon as it is stabilized.

## **3.2 Section 2. Purple High-Level Requirements**

Offeror's technical proposal response (Volume 1, Section 2) shall contain a detailed point-by-point response to Section 2 of the Statement of Work with the same numbering scheme as the Statement of Work. It will include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), and target requirements (TR-1, TR-2 and TR-3) will be met or exceeded, as well as a discussion of University and Offeror identified additional performance features included in the technical solution.



### **3.3 Section 3. Purple C Option**

Offeror's technical proposal response (Volume 1, Section 3) shall contain a detailed discussion of how the architecture presented in section Volume 1, Section 2 will scale up to meet the requirements of Statement of Work Section 3. The response shall include a complete description of the proposed Purple C Option hardware architecture. The response shall, at a minimum, address the following issues: 1) interconnect scaling (link bandwidth, bi-section bandwidth, delivered MPI bandwidth and latency as a function of the number of MPI tasks in the job); 2) number of nodes in the system; 3) architecture for global I/O and external networking subsystems including SAN; 4) RAS; 5) effect of larger system on proposed software scaling (e.g., CWFS, CARM); 6) delivered performance on the ASCI marquee applications.

If Offeror's proposed technical approach proposed for meeting the Purple C Option requirements differs substantially from the technical approach proposed for meeting Purple High-Level Requirements, then the Offeror's technical proposal response shall contain a point-by-point response to Section 2 of the Statement of Work with the same numbering scheme as the Statement of Work with notation on Section 2 requirements that are superseded by those in Section 3. It will include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), and target requirements (TR-1, TR-2 and TR-3) will be met or exceeded, as well as a discussion of University and Offeror identified additional performance features included in the technical solution.

### **3.4 Section 4. EDTV High-Level Requirements**

Offeror's technical proposal response (Volume 1, Section 4) shall contain a detailed point-by-point response to Section 4 (applied to the EDTV system) of the Statement of Work with the same numbering scheme as the Statement of Work. It will include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), and target requirements (TR-1, TR-2 and TR-3) will be met, as well as a discussion of University and Offeror identified additional performance features included in the technical solution.

### **3.5 Section 5. Visualization Requirements**

Offeror shall propose how to meet the ASCI Visualization requirements. Two alternatives are considered in Section 5 of the Statement of Work. The Offeror may propose one or both of these alternatives. Offeror's technical proposal response (Volume 1, Section 5) shall contain a detailed point-by-point response to Section 5 of the Statement of Work with the same numbering scheme as the Statement of Work that corresponds to the Offeror chosen alternative. It will include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), and target requirements (TR-1, TR-2 and TR-3) will be met, as well as a discussion of University and Offeror identified additional performance features included in the technical solution.

### **3.6 Section 6. Integrated System Requirements**

Offeror's technical proposal response (Volume 1, Section 6) shall contain a detailed point-by-point response to Section 6 of the Statement of Work with the same numbering scheme as the Statement of Work. It will include a detailed discussion of **how** all of the mandatory requirements (MR), mandatory option requirements (MO), and target requirements (TR-1, TR-2 and TR-3) will be met, as well as a discussion of University and Offeror identified additional performance features included in the technical solution.

The "Reliability, Availability, Serviceability and Maintenance" subsection shall contain a detailed description all facts relating to the reliability, availability and serviceability of the EDTV and Purple systems and technology refreshes, as appropriate. In particular, provide the Mean Time Between

Failures (MTBF) calculation for each. This calculation shall be performed using a recognized standard. Examples of such standards are Military Standard (Mil Std) 756, Reliability Modeling and Prediction, which can be found in Military Handbook 217F, and the Sum of Parts Method outlined in Bellcore Technical Reference Manual 332. In the absence of relevant technical information in the proposal, the University is forced to make pessimistic reliability, availability and serviceability assumptions in evaluating the proposal.

This section shall describe in detail the proposed hardware and software maintenance strategy throughout the life of the Subcontract. Include the level of service you intend to provide at various points during the Subcontract period (i.e., system build, system installation, acceptance testing, capability period and general availability period). Specific roles and responsibilities for University, Offeror and subcontractors personnel should be delineated. Identify the number of full-time maintenance personnel dedicated to servicing the systems as well as their level of experience on the equipment and software being provided, their training, and other relevant qualifications. Include problem escalation procedures and the process for generating, tracking, and closing trouble tickets. Identify the job category level of the Analysts to be provided as well as your company's job description of that job category. The University will provide office space for on-site support personnel, storage space for spare parts, and Q-clearance allocations. Specific elements of the spare parts cache and on-site hot spares shall be itemized. Failed hardware return mechanism and parts cache refresh policy shall be discussed.

Software maintenance procedures shall be delineated. For instance, describe how (who does what) the following problems previously observed on ASCI scale systems would be reported, analyzed to root cause, fixed, tested and hardware replacements or software patches provided to LLNL and how are they will be tested at LLNL.

- The OS block device buffer cache mechanism fails to release memory and the OS tends to accumulate memory over time which causes nodes to have differing amount of memory available to user applications. The symptom seen by the University is that ASCI application launch fails periodically and some jobs hang when they start paging.
- There is a race condition on the cluster interconnect adapter firmware that allows message data payloads to be randomly overwritten on an infrequent basis. The symptom seen by the University is that ASCI applications experience random bad answers and this is tracked down by them to MPI messages that seem to become randomly corrupted.
- There is a bug in SMP firmware that misdiagnoses power levels when floating point and memory bandwidth intensive applications run. The symptom seen by the University is that running a particular application causes random nodes to power off.
- There is a bug in the resource management software, caused by a race condition, that hangs the resource management system when multiple nodes are added or removed from the cluster interconnect. The symptom seen by the University is that rebooting the system always fails when the resource management system hangs and can not be killed or restarted. The only recourse is to reboot the system, which of course repeats the symptom. The system is not usable.
- There is a bug in the global file system buffering logic that causes large numbers of I/O requests to be retransmitted under heavy load conditions. The symptom seen by the University is that parallel I/O performance increases when more and more MPI tasks are added to the concurrent I/O, until a critical threshold at which time the system becomes unresponsive and must be rebooted.

The Offeror's response shall include the Offeror's strategy for meeting the ESP rating. ESP data for existing systems shall be provided, if available. Specific goals for ESP rating performance as a function of time shall be delineated.

### **3.7 Section 7. Facilities Requirements**

Offeror's technical proposal response (Volume 1, Section 7) shall contain a detailed point-by-point response to Section 7 of the Statement of Work with the same numbering scheme as the Statement of Work. Include detailed information about projected actual power loads that will be present based on the proposed systems, not projected "fully configured" estimates. Give the basis for the estimates. In other words, are these theoretical estimates or are they based on component or full SMP measurements?

**Floor Plans.** Provide a separate floor plan for each of the systems proposed, including any subsystems (e.g., I/O cabinets, disks, cabling, external networking, etc.). The floor plan will include a diagram of asset placement, as well as floor-loading information, and under-floor clearance requirements and placement and type of required electrical outlets.

Provide the estimated total amount of power in kW (kilowatts) required for each of the systems proposed, including any subsystems (e.g., I/O cabinets, disks, cabling, external networking, etc.). The plan will also include the estimated total amount of cooling in BTU (British Thermal Units) or Tons AC required for each of the systems proposed. List any other facilities requirements.

### **3.8 Section 8. Project Management**

Offeror's technical proposal response (Volume 1, Section 8) shall contain a detailed point-by-point response to Section 8 of the Statement of Work with the same numbering scheme as the Statement of Work. In particular provide the following detailed information.

#### **3.8.1 Section 8.2.1. Draft Full Term Management Plan**

In this section of the response the Offeror will provide a first draft full term management plan as outlined in SOW Section 8.2.1. This draft plan will contain the proposed management teams and structure, proposed organization of core team, rough draft full term project plan and schedule that contains a work breakdown structure (WBS) including the proposed milestones to at least five (5.0) levels of detail (in Microsoft Project 2000 format) and risk management plan that includes at least five (5.0) identified risk with HIGH impact to the program with at least MEDIUM or HIGH probabilities of occurrence for each of the hardware and software development activities (a total of ten (10.0) risks). The risks should be associated with development activities on the critical path of the WBS. Failure to identify these risks will severely negatively impact the evaluation of Offeror's qualifications and credibility of schedule. That is, it is much worse to withhold information or appear naive by being unable to identify the requested number of risks than to honestly identify risks. For identified risks, Offeror will propose fall-back strategies that would become operative should the system implementation not proceed as rapidly as scheduled as well as decision dates. Name key personnel that will be part of the project management. Provide the resume of these individuals and a description of the roles and responsibilities in the format shown in Appendix B. Also indicate the level of authority this individual will carry within the corporation for the management of this activity.

**3.8.2 Section 8.2.2. Draft Full-Term Hardware Development Plan**

In this section of the response the Offeror will provide a first draft full-term hardware development plan as outlined in SOW Section 8.2.2. This draft plan will contain the high level development, testing and build strategies for the components outlined in Section 8.2.2. Tie this development plan into the deliveries to the University with specific EDTV, technology refresh and Purple deliveries identified in the milestone section.

**3.8.3 Section 8.2.3. Draft Full-Term Software Development Plan**

In this section of the response the Offeror will provide a first draft full-term software development as outlined in SOW Section 8.2.3. This draft plan will contain the high level development, testing and build strategies for the components outlined in Section 8.2.3. Tie this development plan into the deliveries to the University with specific EDTV, technology refresh and Purple deliveries identified in the milestone section.

**3.8.4 Section 8.2.4. Draft Detailed Year Plan**

In this section of the response the Offeror will provide a first year draft project plan for the build and testing, demonstration and deployment of the EDTV system as described in SOW Section 8.2.4.

**3.8.5 Section 8.3. Proposed Project Milestones**

Offeror will propose a series of project milestones along the lines of those suggested in the SOW Section 8.3. Offeror will give specific deliverables at each milestone (including SOW section numbers), and corresponding milestone delivery/completion dates. An associated Milestone Payment Schedule should be supplied in the Price Proposal (Volume IV) Section 4.

**3.8.6 Section 8.4. Open Source Collaboration**

This section may discuss how the partnership will collaborate, over the term of this contract and beyond, on open source development, if proposed. Of particular interest is how the open source development efforts feed into the delivery of technology refreshes, EDTV and the Purple system. Of great interest is what impact does this have on software support and enhancement over the life of the contract. Include a model of how you think resource (hardware and people) should be used to support development and software service activities (e.g., bug fix testing, etc).

**3.9 Section 9. Performance of the System**

Offeror's Technical Proposal response (Volume 1, Section 9) shall contain a detailed response to Section 9 of the Statement of Work with the same numbering scheme as the Statement of Work.

The benchmark programs described below will be executed by the Offeror for the purpose of measuring the execution characteristics and compiler capabilities of the reference system to the extent defined in the benchmark readme file for each code. The tests will be run on a configuration as described in SOW Section 9.3 according to the testing procedures described in SOW Section 9.4. In addition to running each benchmark separately and reporting those results, the Offeror will run the benchmark codes as a workload to obtain the ESP rating as described in SOW Section 9.5 and report those results as indicated in Section 9.5. For details on running each of the benchmarks, please refer to the following URLs:

[http://www.llnl.gov/asci/purple/benchmarks/limited/code\\_list.html](http://www.llnl.gov/asci/purple/benchmarks/limited/code_list.html)

Tier 1

<http://www.llnl.gov/asci/purple/benchmarks/limited/sppm/sppm.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/umt/umt1.2.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/presta/presta.readme.bm.html>  
[http://www.llnl.gov/asci/purple/benchmarks/limited/memory/membench\\_bm\\_readme.html](http://www.llnl.gov/asci/purple/benchmarks/limited/memory/membench_bm_readme.html)  
<http://www.llnl.gov/asci/purple/benchmarks/limited/parbencch/parbencch.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/super/super.readme.bm.html>

## Tier 2

[http://www.llnl.gov/asci/purple/benchmarks/limited/smg/smg2000\\_bm\\_readme.html](http://www.llnl.gov/asci/purple/benchmarks/limited/smg/smg2000_bm_readme.html)  
<http://www.llnl.gov/asci/purple/benchmarks/limited/mdcask/mdcask.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/ior/ior.posix.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/ior/ior.mpio.readme.bm.html>

## Tier 3

<http://www.llnl.gov/asci/purple/benchmarks/limited/aztec/aztec.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/sage/sage.readme.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/sphot/sphot.read.bm.html>  
<http://www.llnl.gov/asci/purple/benchmarks/limited/irs/irs.read.bm.html>

Changes to accommodate unique hardware and software characteristics of a system that are consistent with the preceding paragraph will be allowed except where specifically prohibited in the constraints for each benchmark. Code modifications will be documented in the form of initial and final source files, with mandatory accompanying text describing the changes. An audit trail will be supplied to the University for any changes made to the benchmark codes. The audit trail will be sufficient for the University to determine that changes made violate neither the spirit of the benchmark nor the specific restrictions on the various benchmark codes. The University requires that all benchmark codes first be run as provided, without any code modifications, in each required configuration and that these baseline results be included along with any results obtained from modified code.

The benchmark programs are available via the Web at the following URL:

<http://www.llnl.gov/asci/purple/benchmarks/>

The individual benchmark codes can be downloaded as tar files. There are two readme files for most benchmarks. The first provides general information about that benchmark including a description of the code, how to build and run it, and any specific information about timing or storage issues. The second readme file contains benchmark specific instructions and constraints. It will also contain expected runs and results, a modification record, and RFP formal questions and answers. Two of the benchmark codes require licensing paperwork be completed to gain access, no cost is involved. ASCI Purple Benchmark questions, and only benchmark related questions, may be submitted via electronic mail to “<mailto:asci-bench@llnl.gov>”. Questions concerning the benchmarks can also be sent by letter to the University Procurement Representative. Copies of all relevant questions and answers, without identification of the requester, will be made available to all Offerors.

The benchmark suite will consist of two “marquee codes” or challenge apps, sPPM and UMT2000 (UMT1.2). These application codes will have specific performance levels that may be met and target optimizations for reasonable effort improvements. In addition to the challenge apps, there will be an additional seven application codes that must be run on the reference system and will be involved in later acceptance of the machine. There will also be three stress test runs required: MPI, Memory, and I/O.

### **All benchmark results must be reported as follows:**

These are the output and measurements that shall be provided by the Offeror for each benchmark.

1. The output of the results generated by each individual benchmark run.

2. Any additional performance measurements as requested in the readme of each benchmark.
3. The CPU time, system time, and wall clock time for the entire execution of each individual benchmark run.
4. All compilation options, the wall clock time required to compile all source code, and the wall clock time to load/link (i.e., create an executable image) for each benchmark. Each compiler option used must have a short description of the purpose of the option.
5. All environment variables and any other system or user settings during execution. Correct execution and measurements shall be certifiable by the University.

In addition to the results obtained for each benchmark on the reference system, the University expects the Offeror to provide estimated scaled performance figures for each benchmark to the EDTV system and to the final full-scale system. All scaling arguments shall be fully described by the Offeror and will be reviewed and evaluated by the University; supporting documentation may be provided. The University will be the sole judge of the validity of any scaled results.

**All benchmark results must be completed to the extent possible and will be scored as follows.**

For all benchmarks, the basis of the overall scoring is to normalize the raw benchmark measurements for each benchmark to the best measurement among the bid systems.

The overall score for vendor  $v$  is:

$$S_v = \sum_{b=1}^{12} w_b n_{v_b}$$

where

$w_b$  is the weight for benchmark  $b$ . The weights sum to 100 points. 20 points for each Marquee code and 6 points for each of the others.

$n_{v_b}$  is the normalized score for vendor  $v$  on benchmark  $b$ .

The normalized score for vendor  $v$  on benchmark  $b$  is given by one of the two following equations. There are two possible equations here because the intent of the benchmarks varies. For some, the best score is the lowest value (e.g., wall clock time); for others, the best score is the largest value (e.g., MFLOPS). The normalized score for vendor  $v$  on benchmark  $b$  is either;

$$n_{v_b} = \frac{r_{v_b}}{r_b^{\max}} \quad (\text{or}) \quad n_{v_b} = \frac{r_b^{\min}}{r_{v_b}}$$

where

$r_{v_b}$  is the raw score for vendor  $v$  on benchmark  $b$

$r_b^{\min}$  is the best score for benchmark  $b$  over all the vendors and for this benchmark the lowest value is best.

$r_b^{\max}$  is the best score for benchmark  $b$  over all the vendors and for this benchmark the highest value is best.

### **Emphasizing the importance of benchmark result completeness.**

The README file will explicitly state the figure of merit for each of the benchmark tests. That is to say, it will state WHAT the Offeror will be judged on for that particular benchmark test and WHAT results will be returned. The University will assess penalty points if the vendor does not complete all Tier one benchmarks. If the Offeror does not run one of the Marquee codes (sPPM or UMT2000), then Offeror will lose all benchmark points. If the Offeror fails to run any of the other Tier one or Tier two benchmarks, they will lose double the allocated points for each missing benchmark. To further extend the reach and importance of the Tier one benchmarks, the University will decrease scores in other (i.e., non-benchmark) areas of RFP scoring for not reporting the Tier one benchmark results. The RFP sections on OpenMP, MPI, hybrid, network, and single CPU performance will be decreased by 50% if Marquee code results are not furnished and by 25% if any of the other Tier one benchmark codes are ignored. Reporting results for the Tier three codes will give the Offeror additional points for those codes.

It is extremely important to provide the University as much benchmark data as possible. Furnishing full results is rewarded more than incremental performance differences between vendors. If a particular Offeror cannot run a particular code or problem for whatever reason, Offeror should justify why they were unable to complete the runs. All benchmark omissions will be fully described by the Offeror and will be reviewed and evaluated by the University; supporting documentation may be provided. The University will be the sole judge of the validity of any arguments and whether or not penalty points shall be applied.

## **3.10 Section 10. Subcontracting**

This section shall describe any use of subcontracting or third parties for major software, hardware components, or services and associated areas of risk and risk mitigation. It should also include a description of how Offeror's organization intends to integrate the Subcontractor's product or services to achieve the ASCI goals. Describe your previous experience with the proposed third-party subcontractors and the experience that the proposed third-party subcontractors have had on projects for similar equipment or services as being provided under this Subcontract.

# **4 BUSINESS PROPOSALS (VOLUME II)**

## **4.1 Section 1. Supplier Attributes**

Provide the following background information on those contracts during the past two years that the Offeror considers the most comparable to the requirements of this RFP in terms of providing high-end computing systems and working with high-end customers and partners to advance the high-end computing state-of-the-art: contract number; contract type; contract value; contract effective date and term; place of performance; client contacts (include the name and phone number of contractual contact and the name and phone number of technical contact); and similarities to University requirements. Offeror is encouraged to include a self-assessment of its performance on these projects including what went well and, more importantly, what did not. Every computer related project has major problems, so a credible response will not say "everything went fine." The University is very interested in how the

Offeror's organization overcame difficulty and ultimately became successful in the face of adversity, not that they avoided obstacles in the first place. Offeror may discuss these challenges in the context of a lessons learned scenario.

If a proposal is submitted by a consortium led by an integrating subcontractor (as opposed to the primary original equipment manufacturer), the proposal should include a detailed management plan that explains the corporate relationships and responsibilities between or among the parties to the consortium. The University believes that only aggressive, top-level management relationships that clearly identify who is responsible for what among the members of the consortium can reduce the performance risk posed by the integrating subcontractor-led consortium approach. In particular, the detailed consortium management plan should clearly delineate responsibility for and corporate commitment to component hardware and software development, hardware and software bug fix, system testing and problem root cause identification and resolution (*FOR ALL PROPOSED HARDWARE AND SOFTWARE*, not only those developed directly by the consortium). The management plan should be detailed enough to unambiguously affix a consortium member corporate commitment to the successful completion of every aspect of hardware and software technology proposed. The detailed management plan should also indicate existing technical expertise levels for the Purple project in each member and indicate where additional resources (hiring) will be obtained and on what timescale. Any areas of important expertise creation or augmentation by the partnership should be identified as a personnel risk in the risk assessment plan.

## **4.2 Section 2. Unix/Linux Product Roadmap**

Describe the corporation's Unix/Linux product roadmap for the next four years. Include hardware and software offerings. Provide information that will give an indication of the depth and scope of the product roadmap as well as the products targeted specifically at high-performance Unix/Linux clustering. Indicate the open source partnerships the corporation is involved in and how the results of these efforts factor into future products.

## **4.3 Section 3. Proposed Open Source Development Partnerships**

The Offeror may provide information on the capabilities of the corporation to engage in an open source development partnership and meet the goals set out in Attachment 2, Statement of Work, Section 2.2. This information should include the Corporation's qualifications as an open source development organization; the source code licensing requirements (i.e., under the terms of which open source license the Corporation has in the past and will in the future, develop software). Specifically indicate the willingness of the corporation to participate in the open source development (including design, component development, component testing and systems/scaling testing), with other partners, of key missing HPTC cluster technology components such as scalability to 60 teraFLOP/s level; scalable parallel file systems and cluster resource scheduling. If the Offeror has technology, such as a scalable parallel file system or cluster management tools or cluster resource scheduling that could be contributed to the overall open source software effort, please indicate that as well.

# **5 ALTERNATE PROPOSALS AND OPTIONS (VOLUME III)**

Offeror is encouraged to provide alternate proposals and options, if your organization thinks more than one alternative is viable, as well as any third party or value added solutions that would be in the best interest of their company and the ASCI program. Any risk-reduction suggestions Offeror has that would increase the company's ability to successfully meet these ASCI requirements should also be included in this section.



## 5.1 University Mandatory Options

Mandatory Option requirements deal with features, components, performance characteristics, or upgrades whose availability as an option the University deems a Mandatory Requirement. Hence, a proposal not meeting a Mandatory Option will be deemed technically nonresponsive. Because the University will variously elect to include or exclude such options in resulting orders, each should appear as a separately identifiable item in the Alternate Proposals and Options (Volume III) and Price Proposal (Volume IV).

One important University defined mandatory option is that the Offeror is also required to propose performance enhancement products available to the University when such products are offered commercially. Enhancements shall include, as a separately priced option, those improvements to increase the peak performance of the Purple system to at least 150 teraFLOP/s. However, no guarantee or warranty is made or implied that such an enhancement to the Purple system will be procured by the University under any Subcontract. The decision to pursue such an option shall be at the sole discretion of the University. If the University elects to execute this option, the target date for delivery will be 4QCY2006.

The following table lists the inclusive set of University Mandatory Options. Offeror shall fully describe the proposal to meet each University Mandatory Option in their Alternate Proposals and Options (Volume III) as an Option in Section 2. This description shall include all technical information for full evaluation of the Option as well as delivery date or schedule. In addition, each University Mandatory Option shall be fully and separately priced in the Price Proposal (Volume IV). A proposal that does not offer separately priced University Mandatory Options will be deemed nonresponsive.

**Table 4**  
**University Mandatory Options**

SOW Section	Option	Description
4.1.1	EDTV-5	Fully configured, complete and functional 5 teraFLOP/s EDTV system with 2.5 TiB of memory and 100 TB of global disk
4.1.2	EDTV-20	Fully configured, complete and functional 20 teraFLOP/s peak EDTV system with 10 TiB of memory and 400 TB of global disk
5.0	EDTV Vis	Visualization hardware and software directly attached to the EDTV cluster interconnect and with sufficient bandwidth to CWFS and external networking to perform ASCI visualization programmatic objectives as described in SOW Section 5.0
2.0	Additional EDTV Compute Rack	On additional Compute SMP rack identically configured as the other EDTV compute SMP racks with full memory, dual boot local disk and cluster interconnect.
2.1.1.10	Additional EDTV-5 Cluster Memory	Add 50% more memory to the proposed EDTV-5 systems.
2.1.1.11	Additional EDTV-5 Compute Node Memory	Double the memory on a single EDTV-5 compute SMP.

SOW Section	Option	Description
2.1.4.9	Additional EDTV-5 Global Disk	Add 25% of total global disk to EDTV-5 cluster CWFS.
2.1.1.10	Additional EDTV-20 Cluster Memory	Add 50% more memory to the proposed EDTV-20 systems.
2.1.1.11	Additional EDTV-20 Compute Node Memory	Double the memory on a single EDTV-20 compute SMP.
2.1.4.9	Additional EDTV-20 Global Disk	Add 25% of total global disk to EDTV-20 cluster CWFS.
5.0	TR Vis	Visualization hardware and software directly attached to the Technology Refresh, if bid, cluster interconnect and with sufficient bandwidth to CWFS and external networking to perform ASCII visualization programmatic objectives as described in SOW Section 5.0
2.0	Additional TR Compute Rack	On additional Compute SMP rack identically configured as the other Technology Refresh compute SMP racks with full memory, dual boot local disk and cluster interconnect, if bid.
2.1.1.10	Additional TR Cluster Memory	Add 50% more memory to the proposed Technology Refresh systems, if bid.
2.1.1.11	Additional TR Compute Node Memory	Double the memory on a single Technology Refresh compute SMP, if bid.
2.1.4.9	Additional TR Global Disk	Add 25% of total global disk to TR cluster CWFS, if bid.
5.0	Purple Vis	Visualization hardware and software directly attached to the Purple cluster interconnect and with sufficient bandwidth to CWFS and external networking to perform ASCII visualization programmatic objectives as described in SOW Section 5.0
2.0	Additional Purple Compute Rack	On additional Compute SMP rack identically configured as the other Purple compute SMP racks with full memory, dual boot local disk and cluster interconnect.
2.1.1.10	Additional Purple Cluster Memory	Add 50% more memory to the proposed Purple systems.
2.1.1.11	Additional Purple Compute Node Memory	Double the memory on a single Purple compute SMP.
2.1.4.9	Additional Purple Global Disk	Add 25% of total global disk to Purple cluster CWFS.
3.0	Purple C Option	Fully configured, complete and functional system with a minimum of 100 teraFLOP/s peak and 130 teraFLOP/s sustained performance on the ASCII marquee applications with 50 TiB of memory and 2.0 PB of global disk.

SOW Section	Option	Description
3.1.1.3	Additional Purple C Cluster Memory	Add 50% more memory to the proposed Purple C Option.
3.1.1.4	Additional Purple C Compute Node Memory	Double the memory on a single Purple C compute SMP.
NA	Purple Upgrade	Fully configured, complete and functional upgrade to Purple to at least the 150 teraFLOP/s peak performance with 75 TiB of memory and 3.0 PB of global disk and other critical system attributes scaled as in SOW Section 2.1.1.2. Target date for this upgrade is 4QCY2006.

## 5.2 Alternate Proposal(s) Format

A separate Technical Proposal (Volume I) and separate Price Proposal (Volume IV) shall be submitted for each Alternate proposal. The same format indicated in Table 1 should be followed for each Alternate proposal submitted. If a majority of the Alternate proposal is the same as the main proposal, duplicate information does not need to be reiterated. In such case, identify the differences between the two. If, however, a significant portion of the Alternate proposal is different from the main proposal, the Alternate proposal should stand-alone. That is, it should follow the same format identified in Table 1 and have sufficient information to allow the University to evaluate it as a stand-alone proposal. Alternate proposals may include pointers to the main proposal.

## 5.3 Alternate Additional Option(s) Format

Offeror is also encouraged to include options they think are of interest to the University. These options should be included in Alternate Proposals and Options (Volume III) of the proposal and priced separately in the Price Proposal (Volume IV, Section 2) and are not considered “alternate proposals.” For the purposes of this solicitation, an “option” is defined as additional equipment or services offered by the Offeror for which the University has the unilateral right to select or not select the option. An “alternate proposal” is defined as an additional proposal presenting a different approach to meeting or exceeding the programmatic requirements of the required systems (e.g., EDTV, technology refresh, and Purple) or other innovative architectures that may be of interest to the ASCI program.

# 6 PRICE PROPOSAL (VOLUME IV)

## 6.1 Section 1. System Prices

Offeror shall fully complete the price schedules contained in Appendix A of this Attachment, in accordance with the instructions contained herein. Modifications to the spreadsheets may be made as necessary.

Offeror shall provide a firm fixed price for each system offered. A separate firm fixed-price shall also be provided for each Alternate proposal submitted. The total price proposed for each system shall include all software and software license costs, unless explicitly noted. The firm fixed-price shall also include all delivery and installation costs. Maintenance prices shall be based on 7 x 24 service for all systems proposed starting with system acceptance and extending for five (5.0) years.

An entry must be made for each line item. If the price of a line item is being offered at “No Charge” to the University insert “NC” for that entry. If a line item cannot be separately priced, insert “NSP” for that entry. In the description column, the Offeror must also insert the entry “Note \_\_\_” directing the University to the “Note” that provides a narrative explanation for all “NSP” entries, identifying which line item includes that price. All accompanying notes shall be included at the end of the price schedule.

## **6.2 Section 2. University and Offeror Defined Options Prices**

Offeror shall fully complete the Optional Equipment Pricing table contained in Appendix A. Pricing should be for a single additional node rack. An entry must be made for each line item. Offeror may include additional options that they think would be of interest to the University. Offeror-defined options must include relevant technical, business, and price information in the appropriate proposal volume.

## **6.3 Section 3. Lower-Tier Subcontractor Price Information**

If the Offeror is proposing to use lower-tier subcontractors, price information for each Subcontractor shall be furnished in the same format and level of detail as prescribed for the prime Offeror.

## **6.4 Section 4. Milestone Payment Schedule**

Provide a “draft” Milestone Payment Schedule according to the Government fiscal year that matches the delivery milestones identified in the Technical Proposal (Volume 1), Section 8.2. The actual Milestone Payment Schedule contained in any resulting Subcontract will be based on the system delivery schedule as well as on the University’s best estimate of anticipated fiscal year allocations for any Subcontract at the time of Subcontract award.

It is the University’s intent to more heavily price milestones that demonstrate that the ASCI applications can run successfully across the entire system. Milestones that reflect only the hardware installation without the accompanying software scalability will be considered of less value for milestone payment purposes.

## **6.5 Section 5. Financial Incentives**

Just as creativity will be required to meet the University’s technical requirements, it is also anticipated that creative financial arrangements will be needed to meet the Laboratory’s budget constraints. Therefore, Offeror is encouraged to propose alternative, creative financial incentives such as lease-to-ownership (LTO) arrangements, purchase with trade-in option, cost share, etc. Any LTO arrangements would have to be part of the resultant University Subcontract. The Laboratory will not enter into a University issued third party LTO. However, the University would consider a financial arrangement whereby the Awardee assigned the LTO to a third party if the rates were consistent with prevailing and competitive rates. The University would also be willing to provide interested companies with the names of third party financial institutions that have done business with the University and understand our environment. In general, an operating lease is not usually considered an attractive financial incentive unless the lease costs offer a significant savings over the direct purchase or LTO financing methods. Offeror is encouraged to look for ways in which the University can obtain title to the equipment at the end of the Subcontract period.

## **6.6 Section 7. Financial Condition and Capability**

To assist the University in assessing the financial capability of the Offeror, provide the following:

- Audited balance sheets and profit and loss statements for the Offeror’s company for the last three completed years, including interim statements for the current year. Also provide copies of your Form 10-K filed with the Securities and Exchange Commission for the past three fiscal years, plus any 10-Q Forms filed since the last Form 10-K.

- Furnish affirmative assurance, such as endorsements from financial institutions, that your company has sufficient funds necessary to perform the work.
- State what percentage of your performing organization's estimated total business during the period of performance this proposed Subcontract will represent.
- State the distribution of your last complete fiscal year's sales volume among commercial business, Government prime contracts, and subcontracts under Government prime contracts.
- Provide a current Dun and Bradstreet Payment Analysis Report (PAR).

Please provide any other relevant and useful information about the financial health of the corporation that will assist the University in assessing the financial capability of the Offeror.

## **7 OTHER DOCUMENTS (VOLUME V)**

### **7.1 Section 1: Royalty Information**

If the offer in response to this solicitation contains costs or charges for royalties totaling more than \$250, the following information shall be included in the response relating to each separate item of royalty or license fee: name and address of licensor; date of license agreement; patent numbers, patent application serial numbers, or other basis on which the royalty is payable; brief description, including any part or model numbers of each item or component on which the royalty is payable; percentage or dollar rate of royalty per unit; unit price of item; number of units; and total dollar amount of royalties.

In addition, if specifically requested by the University Procurement Representative before award, the Offeror shall furnish a copy of the current license agreement and an identification of applicable claims of specific patents or other basis upon which the royalty may be payable.

### **7.2 Section 2: Integrated Safety Management (ISM) Requirement**

ISM is a systematic approach to integrating safety into work planning and execution. In the ISM context, the term safety is synonymous with the University term "environment, safety, and health" (ES&H). It encompasses protection of employees, the public, and the environment.

All Subcontractor personnel working on-site may be required to satisfactorily complete safety training specific to the facility in which the work will be performed. The Subcontract Statement of Work, a separate list of required ISM training, or similar contractual document will specify the required training courses and course hours. Subcontractor costs for ISM training are reimbursable under the Subcontract to the extent that the costs are identified in the Subcontractor's proposal and incorporated into the resulting Subcontract by the University.

### **7.3 Section 3: Software Branding and Licensing**

Submit all branding or certification of software standards adherence required in Attachment 2, Statement of Work, Section 2.2.

Submit licensing policies for all categories of software (compilers, libraries, application development tools, etc.) that will be provided under any resulting Subcontract. Identify all third-party software. Include policies for cluster-wide right-to-use licenses for an unlimited number of users for all software that will be delivered under any resulting Subcontract. Include any required Software License or Maintenance Agreement as well as any licensing requirements for source code. The following conditions must be incorporated in any resulting license agreement or maintenance agreement:

- The governing laws of the state of California;

- The right of assignment of any agreement to the Department of Energy (DOE) for assignment to any succeeding prime contractor to the University. An Offeror's proposal may be considered non-compliant in the event the Offeror and the University cannot mutually agree to terms and conditions contained in any Software License or Maintenance Agreement.

#### **7.4 Section 4: System Warranty Information**

Provide warranty information for all Offeror-provided items as well as any third-party subcontracted items.

#### **7.5 Section 5: Representations and Certifications**

Complete and return Attachment 12.

#### **7.6 Section 6: EEO Pre-Award Compliance Certification Form**

Complete and return Attachment 13.

#### **7.7 Section 7: Supplier's Industrial Safety Record**

Complete and return Attachment 14.

## Appendix A Price Schedules

The following Price Schedule 1 shall be completed for any of the EDTV, Technology Refresh and Purple clusters proposed. If the Offeror is not proposing one or more of the cluster components, then that section should be labeled with "NOT BID".

Price Schedule 1 EDTV, Technology Refresh and Purple Clusters		
	Price	Notes
<b>5.0 teraFLOP/s EDTV Cluster:</b>		
<b>Hardware:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
SAN networking		
Global I/O Subsystem		
External Networking		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
<b>5.0 TF/s EDTV HW Subtotal:</b>		
<b>Software:</b>		
Operating System		
Debugger		
Compilers		
Parallel Development Tools		
Performance Analysis Tools		
Resource Management		
Configuration Management		
DCE		
MPI		
OpenGL		
Scientific Libraries		
Global File System		
<b>5.0 TF/s EDTV SW Subtotal:</b>		
<b>Maintenance:</b>		
5yrs Hardware Maintenance		
5yrs Software Maintenance		
<b>5.0 TF/s EDTV Maint Subtotal:</b>		
Other (List Each Item)		
<b>5.0 TF/s EDTV Other Subtotal:</b>		
<b>5.0 TF/s EDTV Cluster Subtotal:</b>		
<b>20.0 teraFLOP/s EDTV Cluster:</b>		

**Price Schedule 1**  
**EDTV, Technology Refresh and Purple Clusters**

	<b>Price</b>	<b>Notes</b>
<b>Hardware:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
SAN networking		
Global I/O Subsystem		
External Networking		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
<b>20.0 TF/s EDTV HW Subtotal:</b>		
<b>Software:</b>		
Operating System		
Debugger		
Compilers		
Parallel Development Tools		
Performance Analysis Tools		
Resource Management		
Configuration Management		
DCE		
MPI		
OpenGL		
Scientific Libraries		
Global File System		
<b>20.0 TF/s EDTV SW Subtotal:</b>		
<b>Maintenance:</b>		
5yrs Hardware Maintenance		
5yrs Software Maintenance		
<b>20.0 TF/s EDTV Maint Subtotal:</b>		
Other (List Each Item)		
<b>20.0 TF/s EDTV Other Subtotal:</b>		
<b>20.0 TF/s EDTV Cluster Subtotal:</b>		
<b>Technology Refresh Cluster:</b>		
<b>Hardware:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
SAN networking		



**Price Schedule 1**  
**EDTV, Technology Refresh and Purple Clusters**

	<b>Price</b>	<b>Notes</b>
Global I/O Subsystem		
External Networking		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
<b>TR HW Subtotal:</b>		
<b>Software:</b>		
Operating System		
Debugger		
Compilers		
Parallel Development Tools		
Performance Analysis Tools		
Resource Management		
Configuration Management		
DCE		
MPI		
OpenGL		
Scientific Libraries		
Global File System		
<b>TR SW Subtotal:</b>		
<b>Maintenance:</b>		
5yrs Hardware Maintenance for additional HW		
5yrs Software Maintenance for additional SW		
<b>TR Maint Subtotal:</b>		
Other (List Each Item)		
<b>Tech Refresh Other Subtotal:</b>		
<b>Tech Refresh Cluster Subtotal:</b>		
<b>Purple Cluster:</b>		
<b>Hardware:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
SAN networking		
Global I/O Subsystem		
External Networking		
Racks and rack components		
Integration and testing		

Price Schedule 1 EDTV, Technology Refresh and Purple Clusters		
	Price	Notes
Shipping		
Installation at LLNL		
<b>Purple HW Subtotal:</b>		
<b>Software:</b>		
Operating System		
Debugger		
Compilers		
Parallel Development Tools		
Performance Analysis Tools		
Resource Management		
Configuration Management		
DCE		
MPI		
OpenGL		
Scientific Libraries		
Global File System		
<b>Purple SW Subtotal:</b>		
<b>Maintenance:</b>		
5yrs Hardware Maintenance		
5yrs Software Maintenance		
<b>Purple Maint Subtotal:</b>		
Other (List Each Item)		
<b>Purple Other Subtotal:</b>		
<b>Purple Cluster Subtotal:</b>		
<b>Applications Analysts:</b>		
<b>Systems Analysts:</b>		
<b>Proposal w/5 TF/s EDTV Total:</b>		
<b>Proposal w/20 TF/s EDTV Total:</b>		

The following Price Schedule 2 shall be completed for any of the systems proposed. If the Offeror is not proposing one or more of the cluster components, then that section should be labeled with "NOT BID".

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
<b>Purple C Cluster:</b>		
<b>Hardware:</b>		
SMPs		
Memory		
Local Disk		

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
Cluster Interconnect		
SAN networking		
Global I/O Subsystem		
External Networking		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
<b>Purple C HW Subtotal:</b>		
<b>Software:</b>		
Operating System		
Debugger		
Compilers		
Parallel Development Tools		
Performance Analysis Tools		
Resource Management		
Configuration Management		
DCE		
MPI		
OpenGL		
Scientific Libraries		
Global File System		
<b>Purple C SW Subtotal:</b>		
<b>Maintenance:</b>		
5yrs Hardware Maintenance		
5yrs Software Maintenance		
<b>Purple C Maint Subtotal:</b>		
Other (List Each Item)		
<b>Purple C Other Subtotal:</b>		
<b>Purple C Cluster Subtotal:</b>		
<b>Additional EDTV Compute SMP Rack:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
SAN networking		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>EDTV Compute SMP Rack Subtotal:</b>		
<b>EDTV Visualization:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
External Networking		
Hardware Graphics Acceleration		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>EDTV Visualization Subtotal:</b>		
<b>Additional TR Compute SMP Rack:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>TR Compute SMP Rack Subtotal:</b>		
<b>Additional Purple Compute SMP Rack:</b>		
SMPs		
Memory		

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
Local Disk		
Cluster Interconnect		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>Purple Compute SMP Rack Subtotal:</b>		
<b>Additional C Purple Compute SMP Rack:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>Purple Compute SMP Rack Subtotal:</b>		
<b>Purple Visualization:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
External Networking		
Hardware Graphics Acceleration		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
5 YR Software Maintenance		
<b>Purple Visualization Subtotal:</b>		
<b>Purple C Visualization:</b>		
SMPs		
Memory		
Local Disk		
Cluster Interconnect		
External Networking		
Hardware Graphics Acceleration		
Racks and rack components		
Integration and testing		
Shipping		
Installation at LLNL		
Software Licenses		
5 YR Hardware Maintenance		
5 YR Software Maintenance		
<b>Purple Visualization Subtotal:</b>		
<b>Additional EDTV SMP Memory:</b>		
<b>Additional Purple SMP Memory:</b>		
<b>Additional Purple C SMP Memory:</b>		
<b>EDTV 5 TiB Memory Upgrade</b>		
Installation		
Memory		
5 YR Hardware Maintenance		
<b>EDTV 5 TiB Mem Upgd Subtotal:</b>		
<b>EDTV 100 TB Disk Upgrade</b>		
Installation		
Disks		
RAID adapters		
Cabinets		
SAN networking		
5 YR Hardware Maintenance		
<b>EDTV 100 TB Disk Upgd Subtotal:</b>		
<b>Purple 15 TiB Memory Upgrade</b>		

Price Schedule 2 Optional Equipment		
Options:	Price	Notes
Installation		
Memory		
5 YR Hardware Maintenance		
<b>Purple 15 TiB Mem Upgd Subtotal:</b>		
<b>Purple 400 TB Disk Upgrade</b>		
Installation		
Disks		
RAID adapters		
Cabinets		
SAN networking		
5 YR Hardware Maintenance		
<b>Purple 400 TB Disk Upgd Subtotal:</b>		
<b>Purple C 25 TiB Memory Upgrade</b>		
Installation		
Memory		
5 YR Hardware Maintenance		
<b>Purple C 25 TiB Mem Upgd Subtotal:</b>		
<b>Purple C 1.0 PB Disk Upgrade</b>		
Installation		
Disks		
RAID adapters		
Cabinets		
SAN networking		
5 YR Hardware Maintenance		
<b>Purple C 1.0 PB Disk Upgd Subtotal:</b>		

**Appendix B**  
**Resume Format**

**Name:**

**Proposed Title/Assignment on Contract:**

**Experience Summary:** (A succinct summary of overall experience and capabilities including the name and phone number of the client that may be used for reference checking):

**Current Assignment** (Include description and from/to dates):

**Current Client/Customer** (Include current address and telephone number):

**Education:**

**Technical Qualifications:**

**Description(s) of Experience relevant to Proposed Contract Assignment:**

**Provide Three Business Related References:**

**List Awards/Honors/Publications:**

*RESUMES MUST NOT EXCEED FOUR (4) PAGES IN LENGTH*

References listed in the resumes may be contacted to verify relevant experience as part of the evaluation process.